A YEAR OF ORNITHOLOGICAL OBSERVATIONS ON VÂLCELE, BUDEASA, BASCOV, PITEŞTI, AND GOLEŞTI RESERVOIRS FROM ROSPA0062 LACURILE DE ACUMULARE DE PE ARGEŞ

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Abstract. In this paper, there are rendered the results of the research performed during February 2013 – January 2014 on the avifauna from Vâlcele, Budeasa, Bascov, Piteşti, and Goleşti reservoirs from the Argeş River, included in ROSPA0062 Lacurile de acumulare de pe Argeş. The 129 observed species belong to 16 orders, Passeriformes being the richest (with 56 species). Goleşti reservoir sheltered the biggest number of species and the biggest number of individuals, a reason for which it creates the general state of the avifauna development from the researched area. The vernal season is highlighted due to the biggest number of species and the hiemal season because of the biggest number of individuals. Broadly, the number of species and the number of individuals increased from upstream to downstream. The biggest similarity, by the Jaccard index, was established between the avicoenoses from Piteşti and Budeasa reservoirs and by the Bray–Curtis index, between the avicoenoses from Vâlcele and Budeasa reservoirs. The diversity values for every reservoir and for every ecological season are medium and there is a little equitability between the strengths of the species, regardless the ecological season. The power regression applied on the specific richness suggests a low rate of the species strength accumulation. 18 species (13.95% of all) were euconstant and 4 species – 3.10%, *Anas platyrhynchos* Linnaeus, 1758, *Aythya ferina* (Linnaeus, 1758), *Fulica atra* Linnaeus, 1758 and *Larus ridibundus* Linnaeus, 1766 – were eudominant as emphasized by both dominancy and Dzuba ecological index of significance. At general level, Anseriformes and Charadriiformes orders were overdominant; Anseriformes order was overdominant every month, except May, Charadriiformes order only in January, July, August, September and October.

Keywords: ROSPA0062, birds, reservoirs, protection.

Rezumat. Un an de observaţii ornitologice pe lacurile de acumulare Vâlcele, Budeasa, Bascov, Piteşti şi Goleşti din ROSPA0062 Lacurile de acumulare de pe Argeş. În această lucrare sunt prezentate rezultatele cercetărilor efectuate, în perioada februarie 2013 – ianuarie 2014, asupra avifaunei lacurilor de acumulare Vâlcele, Budeasa, Bascov, Piteşti şi Goleşti de pe râul Argeş, cuprinse în ROSPA0062 Lacurile de acumulare de pe Argeş. Cele 129 de specii observate aparţin la 16 ordine, dintre care Passeriformes a fost cel mai bine reprezentat (cu 56 de specii). Lacul de acumulare Goleşti se evidenţiază prin cel mai mare număr de specii şi cel mai mare număr de exemplare, acesta imprimând tabloul general al evoluţiei avifaunei din zona studiată. Prin cel mai mare număr de specii se remarcă sezonul vernal, iar prin cel mai mare număr de exemplare, sezonul hiemal. S-a observat că, în general, numărul de specii şi numărul de exemplare cresc din amonte spre aval. Cea mai mare similaritate, după indicele Jaccard, a fost stabilită între avicenozele lacurilor Piteşti şi Budeasa, iar după indicele Bray–Curtis, între avicenozele lacurilor Vâlcele şi Budeasa. Valorile diversităţii pentru fiecare lac în parte şi pentru fiecare sezon ecologic sunt medii şi există o mare inechitabilitate între efectivele speciilor, indiferent de sezon. Regresia putere aplicată asupra bogăţiei specifice sugerează o rată scăzută de creştere a efectivelor speciilor. 18 specii (13,95% din total) au fost euconstante, iar 4 specii – 3,10% din total, *Anas platyrhynchos* Linnaeus, 1758, *Aythya ferina* (Linnaeus, 1758), *Fulica atra* Linnaeus, 1758 şi *Larus ridibundus* Linnaeus, 1766 – au fost eudominante, atât din punctul de vedere al dominanţei, cât şi al indicelui de semnificaţie ecologică Dzuba. La nivel general, ordinele Anseriformes şi Charadriiformes au fost supradominante. Ordinul Anseriformes a fost supradominant în fiecare lună, cu excepţia lui mai, iar ordinul Charadriiformes numai în ianuarie, iulie, august, septembrie şi decembrie.

Cuvinte cheie: ROSPA0062, păsări, lacuri de acumulare, protecţie.

INTRODUCTION

The study of the fauna from reservoirs is very important because it offers an interesting image of the anthropogenic pressure on the natural environment. Regarding the avifauna, on the one hand, these dam basins destroy the former habitats that were on the respective segments of the rivers and, on the other hand, they create other habitats. In this manner, these new spaces change the qualitative and quantitative characteristics of the bird coenoses and, if they are correctly administrated, they can finally have a positive effect on the birdfauna.

Such research studies were developed on the reservoirs from the upper and middle course of the Argeş River immediately after the ending of their construction (MĂTIEŞ, 1969; MUNTEANU & MĂTIEŞ, 1983) and until now (CONETE et al., 2008, 2011; CONETE, 2011; GAVA, 1997; GAVA et al., 2004a,b, 2007, 2011; MESTECĂNEANU et al., 2004, 2010, 2013, etc.).

MATERIAL AND METHOD

The avifauna of Vâlcele, Budeasa, Bascov, Piteşti, and Goleşti reservoirs was the subject of this work. These dam basins appertain to a series of reservoirs that were built on the course of the Argeş River beginning with 1965 (Fig. 1). Recently, they have been included in the protected area ROSPA0062 Lacurile de acumulare de pe Argeş, component of the Natura 2000 network. From upstream to downstream, their surface is: 640 ha – Vâlcele, 643 ha – Budeasa, 140 ha – Bascov, 150 ha – Piteşti and 680 ha – Goleşti (cf. http://www.baraje.ro). They are situated in the south of the Făgăraş and Iezer – Păpuşa Mountains. Argeş Platform is in the North, Cotmeana Platform is in the West, Cândeşti Platform is in the East, and Piteşti High Plain is in the South.

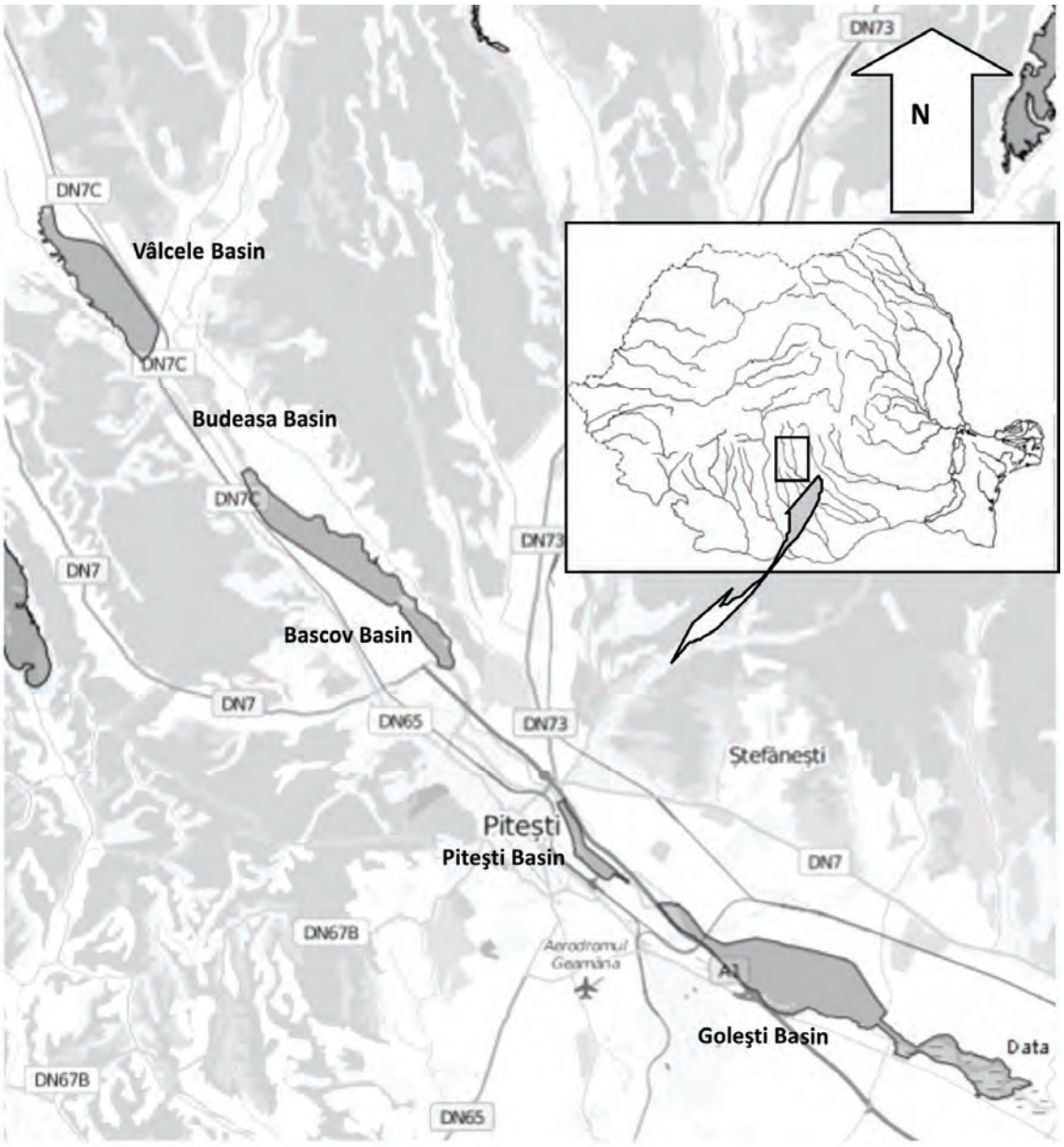

Figure 1. The map of the area.
(by http://biodiversitate.mmediu.ro, modified).

The vegetation is typical of wetland areas, chiefly with reed beds, bulrush, alder, and willow. Depending on the process of silting, it occupies variable surfaces and generally, it is disposed upstream and in the median parts of each reservoir, along the banks. The terrain from the vicinity has different roles. The hills are covered with orchards, broad leaf forests (beech, hornbeam, diverse species of oak, etc.), sparse artificial coniferous forests and grasslands. The meadows are cultivated with cereals, fodder, green goods, etc. The settlements are placed mainly at the foothills or in the meadows and, generally, close to the reservoirs.

The continental climate with hilly characteristics is specific to the area. The average annual temperature of the water is 9^0C at Piteşti, few degrees colder upstream and about 1^0C warmer downstream. In winters, when temperature decreases for a longer period of time below 0 ^{0}C, mainly in January, a bridge of ice is formed (BARCO & NEDELCU, 1974).

For the bird surveillance, it was used the itinerary method, combined to one of the fixed point of observations (where the field conditions were inadequate). Between 10 and 20 of each month, from the period February 2013 – January 2014, one day field trip was performed at all reservoirs. The same track (the most favourable for the observation of water birds from the banks) was traversed every time. Binoculars (10x50), a spotting scope (14–45x50) and a photo device (42x optical zoom) were used.

The scientific nomenclature and classification of the birds are compatible with the Hamlin Guide (BRUUN et al., 1999) and the ecological indices are the ones used in the scientific literature (GACHE, 2002; GOMOIU & SKOLKA, 2001).

RESULTS AND DISCUSSIONS

Between February 2013 and January 2014, 129 bird species and 85,318 individuals were observed on Vâlcele, Budeasa, Bascov, Piteşti, and Goleşti reservoirs (Table 1). They belong to 16 orders: Gaviiformes (1 species), Podicipediformes (4 species), Pelecaniformes (3 species), Ciconiiformes (8 species), Anseriformes (15 species), Falconiformes (5 species), Galliformes (2 species), Gruiformes (3 species), Charadriiformes (20 species), Columbiformes (3 species), Cuculiformes (1 species), Strigiformes (1 species), Apodiformes (1 species), Coraciiformes (3 species), Piciformes (3 species) and Passeriformes, the best represented (56 species). The number of species varied between 36 (in December) and 66 (in August) but also in April it was registered a big number (61), and, for many Charadriiformes and other wetland birds, this corresponds to the period of autumn, respectively spring migration. The number of individuals was the highest in February (19,017 individuals) and November (11,568 individuals), largely reflecting the migratory dynamics of the birds from the Anseriformes and Charadriiformes orders, and the smallest from March to July, with the minimum in May (808 individuals). These suggest a relative small number of breeding birds in the area. Analysing the evolution of these parameters in relation with the average temperature of the air recorded at Piteşti Weather Station every month (cf. rp5.ru) we notice that there is a better correlation between the number of the species and the temperature of the air (0.68, positive and good correlation) than between the strengths of species and the temperature of the air (–0.46, negative and acceptable correlation), fact that was evidenced for the hiemal season (MESTECĂNEANU & GAVA, 2015), too. Also, we observe that, generally, while the number of species increases as the air temperature increases and inversely, the number of species decreases as the air temperature decreases, the strength of species increases as the air temperature decreases and inversely, the strength of species decreases as the air temperature increases.

As against the status of the birds of all the dam basins from the upper and middle course of the Argeş River, registered in the second half of the last century, when there were over 10,000 individuals in the optimal season, we observe now a better situation (with almost 20,000 individuals in February, only on the dam basins between Vâlcele and Goleşti) that indicates that the reservoirs are into a stage of advanced stability of the avifauna (which means a constant periodicity of the species and of their strengths), condition determined by the phenomena of eutrophication of water, initially oligotrophic (MUNTEANU & MĂTIEŞ, 1983).

Table 1. The occurrence of the birds along the year and some ecological indexes.

No.	Species	January	February	March	April	May	June	July	August	September	October	November	December	Absolute abundance	Class of constancy	Class of dominancy	Class of Dzuba index of ecological significance
	I. Order **Gaviiformes**																
1	*Gavia arctica* (Linnaeus, 1758)*												+	3	C1	D1	W1
	II. Order **Podicipediformes**																
2	*Podiceps cristatus* (Linnaeus, 1758)*	+	+	+	+	+	+	+	+	+	+	+	+	1352	C4	D2	W3
3	*Podiceps grisegena* Boddaert, 1783								+					2	C1	D1	W1
4	*Podiceps nigricollis* Brehm, 1831*				+			+	+					14	C1	D1	W1
5	*Tachybaptus ruficollis* (Pallas, 1764)*	+	+	+				+	+	+	+	+	+	185	C3	D1	W2
	III. Order **Pelecaniformes**																
6	*Phalacrocorax carbo* (Linnaeus, 1758)*	+	+	+	+	+	+	+	+	+	+	+	+	1163	C4	D2	W3
7	*Phalacrocorax pygmeus* (Pallas, 1773)*	+	+	+								+	+	109	C2	D1	W1
8	*Pelecanus crispus* Bruch, 1832*						+		+					13	C1	D1	W1
	IV. Order **Ciconiiformes**																
9	*Ixobrychus minutus* (Linnaeus, 1766)*					+		+	+					4	C1	D1	W1
10	*Egretta garzetta* (Linnaeus, 1766)*				+	+	+	+	+					138	C2	D1	W1
11	*Egretta alba* (Linnaeus, 1758)*	+	+	+	+					+		+	+	60	C3	D1	W1
12	*Ardeola ralloides* (Scopoli, 1769)*					+								1	C1	D1	W1
13	*Ardea cinerea* Linnaeus, 1758*	+	+	+	+	+	+	+	+	+	+	+	+	148	C4	D1	W2
14	*Ardea purpurea* (Linnaeus, 1766)*			+										1	C1	D1	W1
15	*Nycticorax nycticorax* (Linnaeus, 1758)*					+	+	+	+					22	C2	D1	W1
16	*Ciconia ciconia* (Linnaeus, 1758)*					+	+	+						14	C1	D1	W1

	V. Order **Anseriformes**															
17	*Cygnus olor* (Gmelin, 1789)*	+	+	+	+	+	+	+	+	+	+	+	+	1202	C4	D2	W3
18	*Cygnus cygnus* (Linnaeus, 1758)*	+	+											21	C1	D1	W1
19	*Anser albifrons* (Scopoli, 1769)*		+										+	660	C1	D1	W2
20	*Anas platyrhynchos* Linnaeus, 1758*	+	+	+	+	+	+	+	+	+	+	+	+	22599	C4	D5	W5
21	*Anas strepera* Linnaeus, 1758*	+	+											22	C1	D1	W1
22	*Anas penelope* Linnaeus, 1758*	+	+	+	+							+	+	208	C2	D1	W2
23	*Anas querquedula* Linnaeus, 1758*			+	+				+	+				291	C2	D1	W2
24	*Anas crecca* Linnaeus, 1758*	+	+	+	+			+	+	+	+	+	+	3639	C4	D3	W3
25	*Anas clypeata* Linnaeus, 1758*	+			+		+		+	+	+			55	C2	D1	W1
26	*Tadorna tadorna* (Linnaeus, 1758)*	+	+						+			+		52	C2	D1	W1
27	*Aythya fuligula* (Linnaeus, 1758)*	+	+	+	+		+	+	+	+	+	+	+	5942	C4	D4	W4
28	*Aythya ferina* (Linnaeus, 1758)*	+	+	+	+	+	+	+	+	+	+	+	+	14140	C4	D5	W5
29	*Aythya nyroca* Güldenstädt, 1770*							+	+					6	C1	D1	W1
30	*Bucephala clangula* (Linnaeus, 1758)*	+	+	+								+	+	490	C2	D1	W2
31	*Mergus albellus* (Linnaeus, 1758)*	+	+								+			8	C1	D1	W1
	VI. Order **Falconiformes**																
32	*Buteo buteo* (Linnaeus, 1758)	+	+	+	+				+	+	+	+	+	19	C3	D1	W1
33	*Circus aeruginosus* (Linnaeus, 1758)*				+				+					3	C1	D1	W1
34	*Falco subbuteo* Linnaeus, 1758						+							1	C1	D1	W1
35	*Falco vespertinus* Linnaeus, 1766									+				1	C1	D1	W1
36	*Falco tinnunculus* Linnaeus, 1758		+	+	+	+	+	+	+			+		11	C3	D1	W1
	VII. Order **Galliformes**																
37	*Phasianus colchicus* Linnaeus, 1758	+	+	+	+	+					+		+	14	C3	D1	W1
38	*Coturnix coturnix* (Linnaeus, 1758)					+								1	C1	D1	W1
	VIII. Order **Gruiformes**																
39	*Porzana porzana* Linnaeus, 1766*							+						1	C1	D1	W1
40	*Gallinula chloropus* (Linnaeus, 1758)*				+	+	+	+	+	+	+			22	C3	D1	W1
41	*Fulica atra* Linnaeus, 1758*	+	+	+	+	+	+	+	+	+	+	+	+	9831	C4	D5	W5
	IX. Order **Charadriiformes**																
42	*Vanellus vanellus* (Linnaeus, 1758)*			+		+	+		+	+				39	C2	D1	W1
43	*Charadrius dubius* Scopoli, 1786*			+	+	+			+					8	C2	D1	W1
44	*Gallinago gallinago* (Linnaeus, 1758)*								+					1	C1	D1	W1
45	*Limosa limosa* (Linnaeus, 1758)*								+					1	C1	D1	W1
46	*Calidris alpina* (Linnaeus, 1758)*								+					1	C1	D1	W1
47	*Calidris minuta* (Leisler, 1812)****								+					2	C1	D1	W1
48	*Actitis hypoleucos* (Linnaeus, 1758)*				+			+	+					25	C1	D1	W1
49	*Tringa ochropus* Linnaeus, 1758*	+	+		+				+				+	10	C2	D1	W1
50	*Tringa glareola* Linnaeus, 1758*								+					22	C1	D1	W1
51	*Tringa nebularia* (Gunnerus, 1767) *					+			+					4	C1	D1	W1
52	*Philomachus pugnax* (Linnaeus, 1758)*								+					4	C1	D1	W1
53	*Recurvirostra avosetta* Linnaeus, 1758*				+									7	C1	D1	W1
54	*Himantopus himantopus* (Linnaeus, 1758)*							+	+					30	C1	D1	W1
55	*Larus argentatus* Pontoppidan, 1763*	+	+	+	+	+	+	+	+	+	+	+	+	2236	C4	D3	W3
56	*Larus canus* Linnaeus, 1758*	+	+							+	+	+	+	2025	C2	D3	W3
57	*Larus ridibundus* Linnaeus, 1766*	+	+	+	+	+	+	+	+	+	+	+	+	13163	C4	D5	W5
58	*Larus minutus* Pallas, 1776*								+					4	C1	D1	W1
59	*Chlidonias niger* (Linnaeus, 1758)*								+					9	C1	D1	W1
60	*Chlidonias hybridus* (Pallas, 1811)*				+	+	+	+	+					24	C2	D1	W1
61	*Sterna hirundo* Linnaeus, 1758*				+	+	+	+						30	C2	D1	W1
	X. Order **Columbiformes**																
62	*Columba palumbus* Linnaeus, 1758					+		+	+	+				10	C2	D1	W1
63	*Streptopelia turtur* (Linnaeus, 1758)					+	+		+					9	C1	D1	W1

64	*Streptopelia decaocto* (Frivaldszky, 1838)	+		+	+	+	+	+	+	+	+	+		30	C4	D1	W1
	XI. Order **Cuculiformes**																
65	*Cuculus canorus* Linnaeus, 1758					+								1	C1	D1	W1
	XII. Order **Strigiformes**																
66	*Athene noctua* (Scopoli, 1769)											+		1	C1	D1	W1
	XIII. Order **Apodiformes**																
67	*Apus apus* (Linnaeus, 1758)				+	+	+	+	+					32	C2	D1	W1
	XIV. Order **Coraciiformes**																
68	*Alcedo atthis* (Linnaeus, 1758)*								+	+	+	+		6	C2	D1	W1
69	*Merops apiaster* Linnaeus, 1758					+								4	C1	D1	W1
70	*Upupa epops* Linnaeus, 1758			+	+			+						5	C1	D1	W1
	XV. Order **Piciformes**																
71	*Picus canus* Gmelin, 1788	+												1	C1	D1	W1
72	*Dendrocopos major* (Linnaeus, 1758)										+	+		4	C1	D1	W1
73	*Jynx torquilla* Linnaeus, 1758				+									1	C1	D1	W1
	XVI. Order **Passeriformes**																
74	*Galerida cristata* (Linnaeus, 1758)		+							+	+	+		6	C2	D1	W1
75	*Alauda arvensis* Linnaeus, 1758			+	+	+	+							10	C2	D1	W1
76	*Riparia riparia* (Linnaeus, 1758)					+	+		+					251	C1	D1	W1
77	*Hirundo rustica* Linnaeus, 1758				+	+	+	+	+	+				204	C2	D1	W2
78	*Delichon urbica* (Linnaeus, 1758)					+	+	+	+					90	C2	D1	W1
79	*Anthus trivialis* (Linnaeus, 1758)				+					+				9	C1	D1	W1
80	*Anthus spinoletta* (Linnaeus, 1758)	+		+							+	+	+	40	C2	D1	W1
81	*Anthus pratensis* (Linnaeus, 1758)										+	+		9	C1	D1	W1
82	*Motacilla flava* Linnaeus, 1758				+	+	+	+	+					32	C2	D1	W1
83	*Motacilla cinerea* Tunstall, 1771*		+											1	C1	D1	W1
84	*Motacilla alba* Linnaeus, 1758		+	+	+	+	+	+	+	+	+			136	C3	D1	W2
85	*Lanius collurio* Linnaeus, 1758					+	+	+	+					8	C2	D1	W1
86	*Lanius excubitor* Linnaeus, 1758				+							+		3	C1	D1	W1
87	*Oriolus oriolus* (Linnaeus, 1758)						+							2	C1	D1	W1
88	*Sturnus vulgaris* Linnaeus, 1758			+	+	+	+	+		+	+	+		371	C3	D1	W2
89	*Garrulus glandarius* (Linnaeus, 1758)	+										+		2	C1	D1	W1
90	*Pica pica* (Linnaeus, 1758)	+	+	+	+	+	+	+	+	+	+	+	+	391	C4	D1	W2
91	*Corvus monedula* Linnaeus, 1758	+	+	+	+	+	+	+	+	+	+	+	+	1260	C4	D2	W3
92	*Corvus frugilegus* Linnaeus, 1758	+	+	+	+	+	+		+	+	+	+	+	1104	C4	D2	W3
93	*Corvus corone cornix* Linnaeus, 1758	+	+	+	+	+			+	+		+	+	21	C3	D1	W1
94	*Corvus corax* Linnaeus, 1758	+	+	+	+	+				+	+	+	+	41	C3	D1	W1
95	*Troglodytes troglodytes* (Linnaeus, 1758)	+	+											2	C1	D1	W1
96	*Prunella modularis* (Linnaeus, 1758)										+	+		5	C1	D1	W1
97	*Locustella luscinioides* Savi, 1824*				+									2	C1	D1	W1
98	*Acrocephalus schoenobaenus* (Linnaeus, 1758)*					+	+							2	C1	D1	W1
99	*Acrocephalus palustris* Bechstein, 1798*				+	+	+	+	+					30	C2	D1	W1
100	*Acrocephalus scirpaceus* Hermann, 1804*				+		+							2	C1	D1	W1
101	*Acrocephalus arundinaceus* (Linnaeus, 1758)*					+	+	+						20	C1	D1	W1
102	*Sylvia borin* Boddaert, 1783						+							2	C1	D1	W1
103	*Sylvia atricapilla* (Linnaeus, 1758)				+		+	+	+					7	C2	D1	W1
104	*Sylvia communis* Latham, 1787					+	+							4	C1	D1	W1
105	*Sylvia curruca* (Linnaeus, 1758)				+									17	C1	D1	W1
106	*Phylloscopus collybita* Vieillot, 1817							+	+	+	+			17	C2	D1	W1
107	*Ficedula albicollis* Temminck, 1815				+									1	C1	D1	W1
108	*Oenanthe oenanthe* (Linnaeus, 1758)				+					+				6	C1	D1	W1
109	*Saxicola rubetra* (Linnaeus, 1758)								+	+				13	C1	D1	W1
110	*Saxicola torquata* (Linnaeus, 1766)				+									1	C1	D1	W1

111	*Erithacus rubecula* (Linnaeus, 1758)			+						+	+	+	5	C2	D1	W1
112	*Luscinia megarhynchos* Brehm C.L., 1831				+	+	+						10	C1	D1	W1
113	*Luscinia luscinia* (Linnaeus, 1758)				+				+				2	C1	D1	W1
114	*Turdus merula* Linnaeus, 1758	+		+			+					+	4	C2	D1	W1
115	*Turdus philomelos* Brehm C.L., 1831			+						+			3	C1	D1	W1
116	*Parus caeruleus* Linnaeus, 1758	+	+				+	+	+	+	+		52	C3	D1	W1
117	*Parus major* Linnaeus, 1758	+	+	+		+	+	+	+		+		27	C3	D1	W1
118	*Remiz pendulinus* (Linnaeus, 1758)*						+	+					8	C1	D1	W1
119	*Passer domesticus* (Linnaeus, 1758)		+	+	+	+	+	+	+	+	+		245	C4	D1	W2
120	*Passer montanus* (Linnaeus, 1758)	+	+		+	+	+	+	+	+	+	+	211	C4	D1	W2
121	*Fringilla coelebs* Linnaeus, 1758	+								+	+	+	47	C2	D1	W1
122	*Coccothraustes coccothraustes* (Linnaeus, 1758)		+										1	C1	D1	W1
123	*Carduelis chloris* (Linnaeus, 1758)				+	+	+	+	+		+		35	C3	D1	W1
124	*Carduelis spinus* (Linnaeus, 1758)										+		7	C1	D1	W1
125	*Carduelis carduelis* (Linnaeus, 1758)	+	+	+	+	+	+	+		+	+	+	65	C4	D1	W1
126	*Carduelis cannabina* (Linnaeus, 1758)		+		+	+					+	+	24	C2	D1	W1
127	*Emberiza schoeniclus* (Linnaeus, 1758)*		+		+					+	+	+	11	C2	D1	W1
128	*Miliaria calandra* (Linnaeus, 1758)		+	+	+	+	+			+	+		34	C3	D1	W1
129	*Emberiza citrinella* Linnaeus, 1758	+	+	+						+	+	+	188	C3	D1	W2

Legend:
* – birds dependent on wetlands; + – presence; C1 – occasional species, C2 – accessory species, C3 – constant species, C4 – euconstant species; D1, W1 – subrecedent species, D2, W2 – recedent species, D3, W3 – subdominant species, D4, W4 – dominant species, D5, W5 – eudominant species; AI, AII, AIII – annexes of the Birds Directive, Bern Convention and, respectively, Bonn Convention, A, B – parts of the annexes.

Referring to the birds that are dependent on wetlands, these totalized 64 species (Table 1) and 80,148 individuals. In the case of the individuals, the graphic is almost identical with the one of individuals from all species (with maximum in February – 18,441 individuals and minimum in May – 382 individuals). Few decades ago, until the construction of the dam basins, there was almost an identical situation, with the richest populations of aquatic birds present during passages and in winter time (MUNTEANU & MĂTIEŞ, 1983). As regards the number of species, more substantial differences emerged: the maximum is clearly in August (41 species), when many Charadriiformes appeared, and the minimum is in October (18 species). Also, in September, March, and, even, in November and December, the number of species was relatively low (Fig. 2). These show that there is also a variation of the species that are not dependent on water, as they come out in bigger numbers from April (32 species) to June and in October and November. In December, they were the worst represented (15 species). From the individuals' point of view, there is a fluctuation of these species, too, the maximum of the curve being in November (1,019) and the minimum in April (229) and July. Compared to the situation registered here 30–35 years ago (MUNTEANU & MĂTIEŞ, 1983), 14 extra species appeared (*Phalacrocorax carbo*, *Pelecanus crispus*, *Circus aeruginosus*, *Recurvirostra avosetta*, *Himantopus himantopus*, *Alcedo atthis*, *Motacilla cinerea*, *Locustella luscinioides*, *Acrocephalus schoenobaenus*, *A. palustris*, *A. scirpaceus*, *A. arundinaceus*, *Remiz pendulinus*, and *Emberiza schoeniclus*), but only some of them are veritable aquatic birds. Most of them are rare. There are some interesting aspects, such as *Phalacrocorax carbo*, that currently is constant (100% frequency) and recedent species (Table 1), *Pelecanus crispus*, vagrant from the Danube Delta and present here many times in the recent years, and the occurrence of the birds from the Passeriformes order, linked mainly by the swamp vegetation appearance. A series of species – *Gavia stellata* (Pontoppidan, 1763), *Botaurus stellaris* (Linnaeus, 1758), *Platalea leucorodia* Linnaeus, 1758, *Plegadis falcinellus* (Linnaeus, 1766), *Ciconia nigra* (Linnaeus, 1758), *Anser anser* (Linnaeus, 1758), *A. erythropus* (Linnaeus, 1758), *A. fabalis* (Latham, 1787), *Anas acuta* Linnaeus, 1758, *Tadorna ferruginea* (Pallas, 1764), *Netta rufina* (Pallas, 1773), *Aythya marila* (Linnaeus, 1761), *Mergus merganser* Linnaeus, 1758, *M. serrator* Linnaeus, 1758, *Pandion haliaetus* (Linnaeus, 1758), *Rallus aquaticus* Linnaeus, 1758, *Porzana parva* (Scopoli, 1769), *P. pusilla* (Pallas, 1776), *Charadrius hiaticula* Linnaeus, 1758, *C. alexandrinus* Linnaeus, 1758, *C. morinellus Linnaeus*, 1758, *Pluvialis apricaria* (Linnaeus, 1758), *P. squatarola* (Linnaeus, 1758), *Lymnocryptes minimus* (Brünnich, 1764), *Numenius arquata* (Linnaeus, 1758), *Calidris ferruginea* (Pontoppidan, 1763), *C. temminkii* (Leisler, 1812), *Tringa totanus* (Linnaeus, 1758), *T. erythropus* (Pallas, 1764), *Limicola falcinellus* (Pontoppidan, 1763), *Haematopus ostralegus* Linnaeus, 1758, *Larus fuscus* Linnaeus, 1758, *Sterna caspia* Pallas, 1770, *S. albifrons* Pallas, 1764) were not observed, because of the short period of research, their low profile or scarcity all over the area.

Regarding the distribution of the species and strengths on reservoirs and periods (months, whole year) we state that Goleşti dam basin held the majority of the species and strength every month. It was followed by Piteşti dam basin, which often overpasses other reservoirs with bigger surface (Budeasa and Vâlcele). As a result, the situation of Goleşti reservoir creates the general situation of the dam basins. Bascov dam basin was generally the last in these hierarchies (Table 2). Very suggestive in this sense are the percentage distributions on whole year: Goleşti had 70.5% of all number of species, respectively 53.9% of all number of individuals, Piteşti – 66.7%, respectively 21.1%, Vâlcele – 50.4%, respectively 10.6%, Budeasa – 46.5%, respectively 12.5% and Bascov – 29.5%, respectively 1.9%.

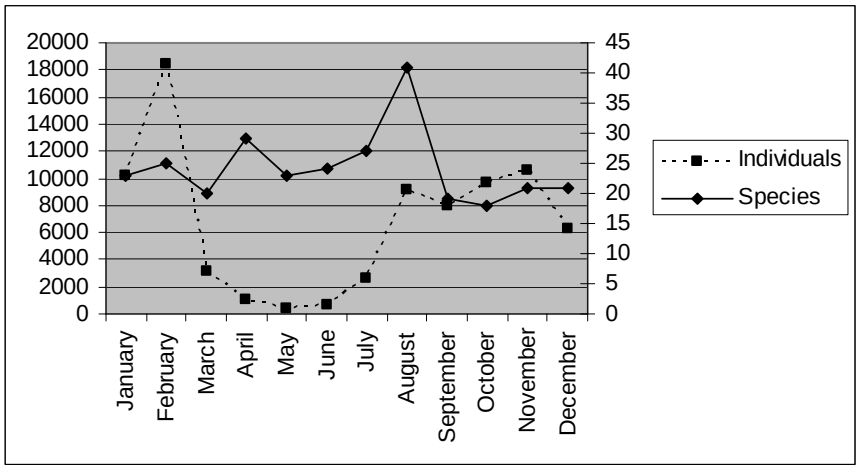

Figure 2. The monthly variation of the number of the individuals and of the number of species dependent on the wetlands.

Regarding the distribution of the species and strengths on reservoirs and ecological seasons, we observe that Goleşti and Piteşti were the first in top (alternatively for the number of species and in this succession for the number of individuals) every considered period and, again, Bascov dam basin was the last, in both situations. The number of species from all the dam basins is the smallest in vernal and autumnal seasons; the biggest number was recorded in prevernal season, but this does not reflect only the dynamics of the birds but the different number of field work from each ecological season, that varied between 1 (in vernal and serotinal) and 4 (in hiemal). The strengths varied by a concave curve: in the hiemal season, it was noted the biggest strength; it decreases to the minimum from the vernal season and increases again to the end of the interval (Table 3). The surface of the dam basins influences partially the facts. So, the correlation between the number of species and the surface was 0.29 and the correlation between the number of individuals and the surface was a 0.43. Both are positive and acceptable correlations (by COLTON, 1974) and this means that the number of species and, mainly, the number of the bird individuals can grow with the increase of the reservoirs surface.

Table 2. The distribution of the species and strengths on reservoirs and intervals of time.

Reservoir	Parameter	January	February	March	April	May	June	July	August	September	October	November	December	All period
Vâlcele	**Species**	15	18	17	23	17	19	15	20	20	22	25	18	65
	Individuals	990	1,098	351	277	298	101	121	394	1,926	1,028	1,239	1,218	9,041
Budeasa	**Species**	13	24	12	18	17	15	17	14	15	21	25	16	60
	Individuals	717	4,989	191	94	90	132	387	200	565	1226	1,189	872	10,652
Bascov	**Species**	10	7	10	8	10	8	9	6	9	8	8	10	38
	Individuals	136	219	229	88	91	63	139	204	104	95	37	215	1,620
Piteşti	**Species**	30	24	21	30	29	37	32	24	19	30	23	17	86
	Individuals	2,523	4,339	407	153	145	260	630	1,205	2,698	778	1,894	3,012	18,044
Goleşti	**Species**	24	28	27	35	28	30	26	42	24	26	25	22	91
	Individuals	6,163	8,372	2,316	607	184	542	1,582	7,505	3,278	6,949	7,209	1,254	45,961

Table 3. The distribution of the species and strengths on reservoirs and ecological seasons.

Reservoir	Parameter	Hiemal	Prevernal	Vernal	Aestival	Serotinal	Autumnal
Vâlcele	**Species**	33	31	17	26	20	31
	Individuals	4,545	628	298	222	394	2,954
Budeasa	**Species**	36	21	17	25	14	25
	Individuals	7,767	285	90	519	200	1,791
Bascov	**Species**	19	14	10	14	6	14
	Individuals	607	317	91	202	204	199
Piteşti	**Species**	41	39	29	47	24	34
	Individuals	11,768	560	145	890	1205	3,476
Goleşti	**Species**	39	44	28	38	42	35
	Individuals	22,998	2,923	184	2124	7505	10,227
All dam basins	**Species**	64	72	54	64	66	54
	Individuals	47,685	4,713	808	3,957	9,508	18,647

As regards the density – the ratio number of species/surface of the reservoir and ratio number of individuals/surface of the reservoir we state that, generally, they grow from upstream to downstream, the exception being Goleşti reservoir (Table 4). So, despite the vicinity of Piteşti, Piteşti reservoir is one of the most preferred places from the area by birds, as we saw with other occasions, too (MESTECĂNEANU & GAVA, 2015; CONETE et al., 2012a). The multiple habitats from here, the lower degree of direct anthropogenic pressure, the position of the reservoir on the course of the Argeş River in the continuation of Rucăr – Bran pass of migration over the Carpathians and near other wetlands from the South of Romania can be the explanation (MĂTIEŞ, 1969; CONETE et al., 2012b; MESTECĂNEANU & GAVA, 2013). Some of the general conditions were stated by other authors on diverse reservoirs from Romania, too (MUNTEANU, 2000; MITRULY, 2002).

Table 4. The ratio number of species/ha and number of individuals/ha for every reservoir.

Reservoir	Number of species	Number of individuals	Number of species/ha	Number of individuals/ha
Vâlcele	65	9,041	0.10	14.12
Budeasa	60	10,652	0.09	16.56
Bascov	38	1,620	0.27	11.57
Piteşti	86	18,044	0.57	120.29
Goleşti	91	45,961	0.13	67.58
Total	129	85,318	0.05	37.86

On the subject of the similarity between the avicoenoses from the reservoirs, by Jaccard index (Table 5, Fig. 3) the biggest similarity is between Piteşti and Budeasa (55.31%) and the lowest between Vâlcele and Bascov (28.75%). By Bray–Curtis index (Table 6, Fig. 4), the highest similarity was between Vâlcele and Budeasa (63.57%) and the lowest between Goleşti and Bascov (6.71%), a situation similar to the one observed in the same area, in the hiemal period, as we showed in a previous work (MESTECĂNEANU & GAVA, 2013). The differences between the values represent the consequences of the detail that the Jaccard index is based only on the presence/absence of the respective species in the samples and the Bray–Curtis index is based on the presence/absence of the species in the samples and on their number of individuals.

Table 5. The similarity matrix (by Jaccard) between the avicoenoses of the reservoirs.

Similarity	Vâlcele	Budeasa	Bascov	Piteşti	Goleşti
Vâlcele	*	47.05	28.75	43.80	45.79
Budeasa	*	*	46.26	55.31	42.45
Bascov	*	*	*	34.78	30.30
Piteşti	*	*	*	*	50.00
Goleşti	*	*	*	*	*

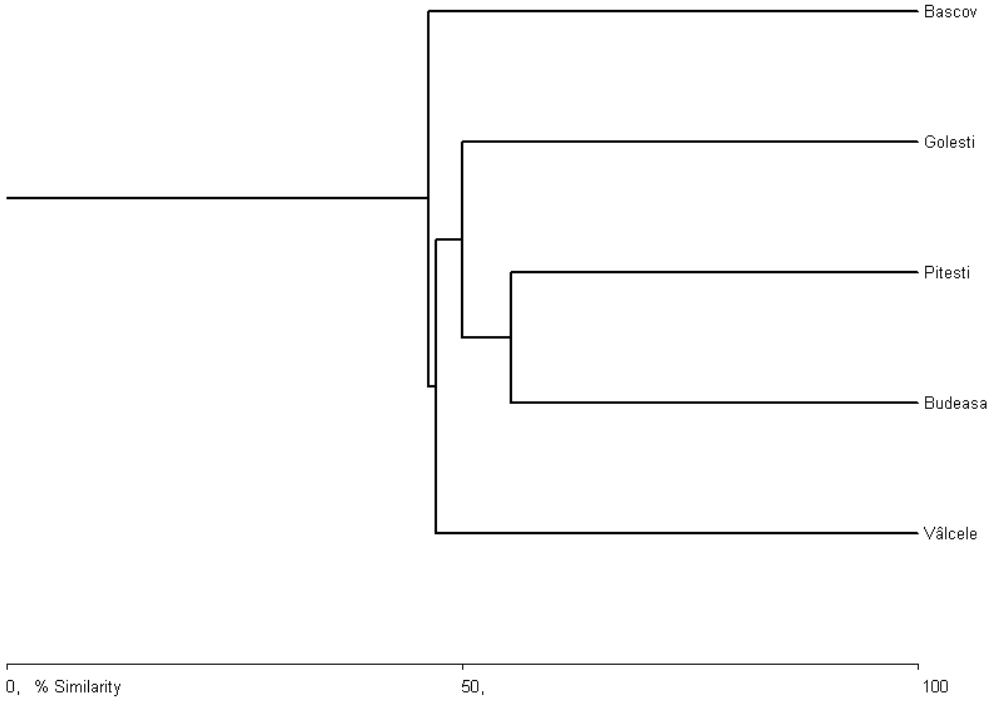

Figure 3. The Jaccard Cluster Analysis (Single Link).

Table 6. The similarity matrix (by Bray–Curtis) between the avicoenoses of the reservoirs.

Similarity	Vâlcele	Budeasa	Bascov	Piteşti	Goleşti
Vâlcele	*	63.57	23.54	44.98	28.19
Budeasa	*	*	25.19	48.58	35.94
Bascov	*	*	*	16.33	6.71
Piteşti	*	*	*	*	47.06
Goleşti	*	*	*	*	*

The Shanon–Wiener ecological diversity was between 2.11 (for Vâlcele) and 2.29 (for Piteşti) and the Simpson ecological diversity was between 4.38 (for Vâlcele) and 5.70 (for Piteşti). For all the dam basins, it was 2.41, respectively 6.95. From the evenness point of view, the smallest evenness was at Goleşti dam basin (0.48, respectively 0.06) and the biggest was at Bascov dam basin (0.60, respectively 0.13). For the whole researched area, it was 0.50 (in case of the Shanon–Wiener index), respectively 0.05 (in case of the Simpson index), (Table 7).

Regarding the ecological seasons, the diversity varied between 2.11 (in the serotinal season) and 2.99 (in the vernal season) for the Shanon–Wiener index and between 4.80 (in the serotinal season) and 12.95 (in the vernal season) for the Simpson index. The corresponding evenness varied, also, between 0.50, respectively 0.07 (in the serotinal season) and 0.75, respectively 0.22 (in the vernal season), (Table 8).

The results reflect the natural spatial and temporal dynamics of the birds, the complexity of the habitats from every dam basin, and the anthropogenic pressure upon each of them. The food and the shelters availability are factors that influence the bird occurrence in the area, too.

It is obvious that, generally, the values of diversity for each coenosis of the reservoirs and for each ecological season are medium. That means that the dam basins do not provide the best ecological area necessary for many bird species, from this point of view the avicoenoses being moderately stable. On the one hand, we observe that the avicoenosis of Vâlcele dam basin is the least diverse and the avicoenosis of Piteşti dam basin is the most diverse and, on the other hand, that the serotinal season is characterised by a moderate stability in the avicoenosis and the vernal season by a better stability. Also, it results that at Goleşti there are few dominant species and at Bascov the strengths of the species are relatively more uniformly distributed. Also, the ecosystems are characterised by a great inequitability regarding the strengths of the species, whatever the ecological seasons. This fact is more obvious in the hiemal and in the passage seasons and a better distribution is in the vernal season.

The differences of the values consist in the fact that the Shannon–Wiener index takes into account both the number of species and the number of individuals of the each species and the Simpson index takes into account the number of individuals of the each species in relationship with the number of individuals of all observed species.

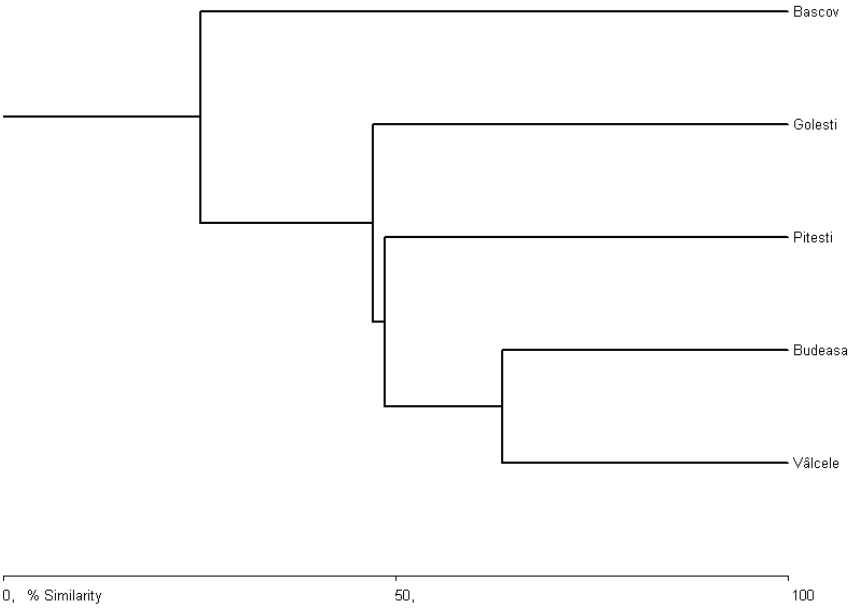

Figure 4. The Bray–Curtis Cluster Analysis (Single Link).

Table 7. The ecological diversity and the evenness of the avifauna from the dam basins.

Dam basin	Shanon Wiener index	Hsmax	Shanon Wiener evenness	Simpson index (1/λ)	S	Simpson evenness
Vâlcele	2.11	4.17	0.50	4.38	65.46346	0.07
Budeasa	2.23	4.09	0.55	5.23	60.33421	0.09
Bascov	2.20	3.64	0.60	4.98	38.88875	0.13
Piteşti	2.29	4.45	0.51	5.70	86.40706	0.07
Goleşti	2.17	4.51	0.48	5.57	91.17855	0.06
Overall	2.41	4.86	0.50	6.95	129.1938	0.05

Table 8. The seasonal ecological diversity and evenness of the avifauna.

Season	Shanon Wiener index	Hsmax	Shanon Wiener evenness	Simpson index (1/λ)	S	Simpson evenness
Hiemal	2.21	4.16	0.53	5.66	64.08467	0.09
Prevernal	2.54	4.28	0.59	6.86	73.10149	0.09
Vernal	2.99	3.99	0.75	12.95	57.79576	0.22
Aestival	2.64	4.16	0.63	7.25	65.03571	0.11
Serotinal	2.11	4.19	0.50	4.80	66.45435	0.07
Autumnal	2.12	3.99	0.53	6.06	54.15393	0.11

If we apply the power regression on the relation between the surface of the every reservoir and their species richness, we state that the slope is positive and quite small and this means that the species rate of accumulation grows slowly as the reservoirs surface increases (Fig. 5). The assertion was observed with other occasions, too (CONETE, 2011) but, in our case, the slope is more accentuated because of the shorter period of observations.

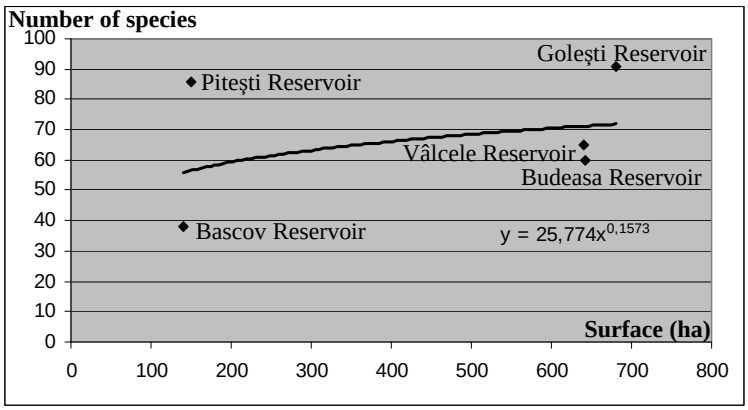

Figure 5. The relation between the surfaces of the reservoirs and their species richness.

According to the constancy (Table 1), 64 species (49.61% of all) were occasional species, 32 species (24.81% of all) were accessory species, 15 species (11.63% of all) were constant species and 18 species (13.95% of all) were euconstant species (*Podiceps cristatus*, *Phalacrocorax carbo*, *Ardea cinerea*, *Cygnus olor*, *Anas platyrhynchos*, *A. crecca*, *Aythya fuligula*, *A. ferina*, *Fulica atra*, *Larus argentatus*, *L. ridibundus*, *Streptopelia decaocto*, *Pica pica*, *Corvus monedula*, *C. frugilegus*, *Passer domesticus*, *P. montanus*, *Carduelis carduelis*). 11 species of the later class are dependent on wetlands (1 from the Podicipediformes order, 1 from the Pelecaniformes order, 1 from the Ciconiiformes order, 5 from the Anseriformes order, 1 from the Gruiformes order and 2 from the Charadriiformes order) and only 6 are Passeriformes; 1 is from the Columbiformes order. Therefore, these were seen most frequently in the observations. 11 species (*Podiceps cristatus*, *Phalacrocorax carbo*, *Ardea cinerea*, *Cygnus olor*, *Anas platyrhynchos*, *Aythya ferina*, *Fulica atra*, *Larus argentatus*, *L. ridibundus*, *Pica pica* and *Corvus monedula*) had even a frequency of 100%, unlike the circumstances from the 1970s–1980s, when without doubt *Anas platyrhynchos* was the most frequent species (MUNTEANU & MĂTIEŞ, 1983).

Depending on the dominancy (Table 1), 116 species (89.92% of all) were subrecedent species, 5 species (3.88% of all) were recedent species, 3 species (2.33% of all) were subdominant species, 1 species (0.78% of all) was dominant species (*Aythya fuligula*) and 4 species (3.10% of all) were eudominant species (*Anas platyrhynchos*, *Aythya ferina*, *Fulica atra*, *Larus ridibundus*). The later species belong to the Anseriformes, Gruiformes and Charadriiformes orders and, thus, they are the most important species as strength in the avicoenosis. The situation is rather dissimilar to the one from the past, when *Anas plathyrhynchos* was the most abundant species; it was distantly followed by *A. querquedula*, *A. crecca*, *Vanellus vanellus* and *Larus ridibundus*; *Fulica atra* was represented by few individuals and *Aythya ferina* and *A. fuligula* were absent (MUNTEANU & MĂTIEŞ, 1983). More recently (MUNTEANU et al., 1989), on diverse types of water bodies from Muntenia and Oltenia, *Anas platyrhynchos* was followed by *A. crecca* (at a little difference in January 1988 and at significant one in January 1989); *Fulica atra* was absent in 1988 and present with important strength in 1989 and *Aythya ferina* and *A. fuligula* were absent at both evaluations. In our case, in the hiemal season, *Aythya fuligula* and *Fulica atra* were the dominant species and *Anas platyrhynchos*, *Aythya ferina*, and *Larus ridibundus* were the eudominant species (see also MESTECĂNEANU & GAVA, 2015). At the census from January 2013 (MESTECĂNEANU et al., 2013), *Anas platyrhynchos* and *Fulica atra* were the eudominant species, *Cygnus olor*, *Anas crecca*, *Aythya ferina*, *Larus argentatus*, and *L. ridibundus* were the dominant species and *Phalacrocorax carbo*, *Aythya fuligula* and *Larus canus* were subdominant species. From these and by comparison to the current situation with the one from the Danube Delta in 1988, 1989, where different species from the genera *Aythya*, *Anas*, *Netta*, *Mergus*, *Cygnus*, etc. were present in relevant number, we can say that over time, the structure of the avifauna from the dam basins from the Argeş River tends to become increasingly more similar to that of a natural ecosystem.

By Dzuba ecological significance index (Table 1), 103 species (79.84% of all) were subrecedent species, 13 species (10.08% of all) were recedent species, 8 species (6.20% of all) were subdominant species, 1 species (0.78% of all) was dominant species (*Aythya fuligula*) and 4 species (3.10%) were eudominant species (*Anas platyrhynchos*, *Aythya*

ferina, *Fulica atra*, *Larus ridibundus*). It is obvious that there are the same dominant and eudominant species as in the case of the dominancy index and they have the biggest ecological importance in the local bird fauna.

Taking into account the index of relation, as we expected, owing to the dominant and overdominant species, Anseriformes and Charadriiformes were the overdominant orders over the whole period. They totalised 66,980 individuals. Gruiformes was the only dominant order: 9,854 individuals. Every other order was complementary. The static axis (As) is 6.25 and the dominance axis (Ad) is 12.5 (Fig. 6).

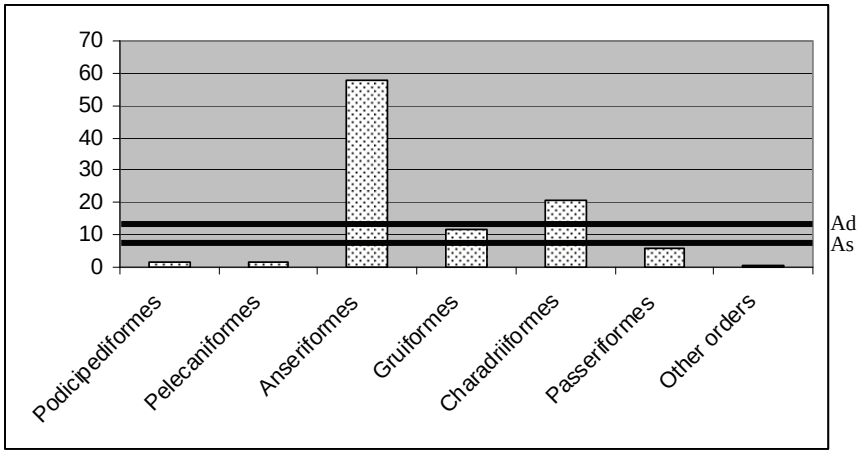

Figure 6. The participation of the orders to the formation of the avicoenosis.

Regarding the monthly dynamics of the orders, it is noticeable that no order was every month overdominant. Anseriformes was overdominant, except May, when it was dominant. Charadriiformes was overdominant in January, July, August, September, and December. From February to May, and in November it was dominant and in June and October it was complementary. Gruiformes was overdominant in March, September, October, and December, dominant in February, April – July, and December, and subdominant in January, August and November. From April to June, Passeriformes became overdominant, in March, July, September and November it was dominant and in the rest of the year it was complementary. Podicipediformes was dominant in April, Pelecaniformes was overdominant in May, dominant in June and July; in the rest of the year these were subdominant. The other orders were complementary every month. The static axis (As) and the dominance axis (Ad) had the same values as in the precedent discussion (Fig. 7).

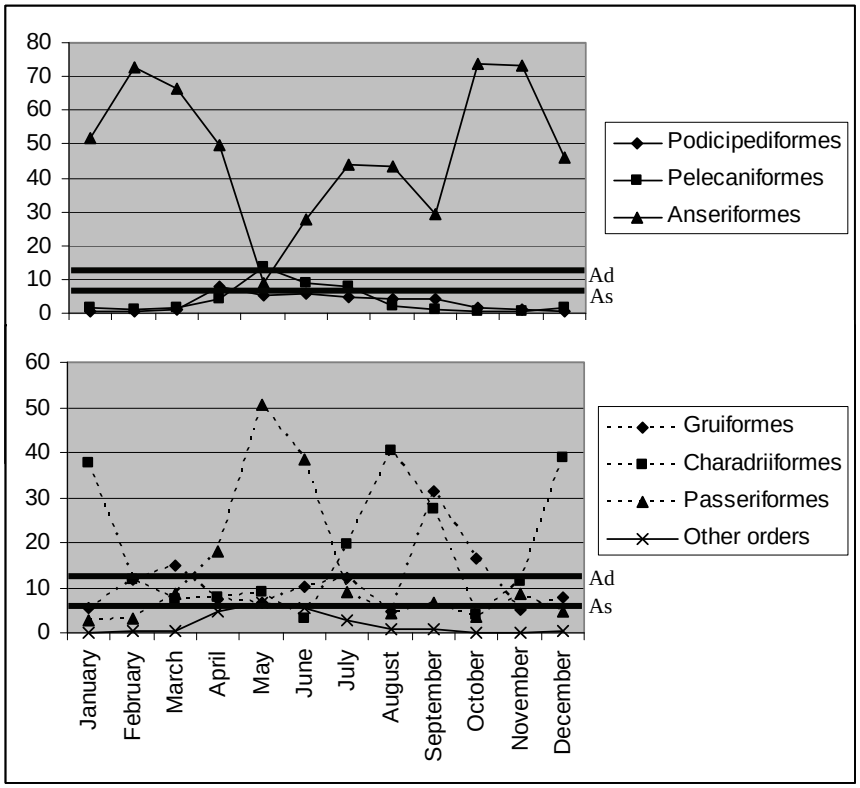

Figure 7. The monthly dynamics of the orders.

CONCLUSIONS

Between February 2013 and January 2014, on the reservoirs Goleşti, Piteşti, Bascov, Budeasa and Vâlcele, from the Argeş River, 129 bird-species and 85,318 individuals were registered.

The identified species belong to 16 orders, Passeriformes being the richest (with 56 species).

In August, it was registered the biggest number of species (66 species) and in February, the highest number of individuals (19,017 individuals); the same thing could be said about the species that depend on wetlands, too (41 species in August, respectively 18,441 individuals in February).

The variation in the number of species and strengths reflects mainly the migratory dynamics of the birds from the Anseriformes and Charadriiformes orders and suggests a relatively small number of breeding birds in the area.

The migratory dynamics of the birds is partially influenced by the air temperature and the occurrence of the birds on reservoirs is also somehow determined by their surface, the habitats from here, the degree of direct anthropogenic pressure, the position of the reservoir on the course of the Argeş River.

Goleşti dam basin detained the majority of the species and strength regardless the period and Bascov dam basin was generally the last.

The species and individuals density, generally, grows from upstream to downstream.

Despite its position next to settlements, Piteşti reservoir is a place that birds prefer.

By Jaccard index the biggest similarity was between Piteşti and Budeasa and the smallest between Vâlcele and Bascov and by Bray–Curtis index, the highest similarity was between Vâlcele and Budeasa and the lowest between Goleşti and Bascov.

Generally, the values of diversity for each coenosis of the reservoirs and for each ecological season are medium, from this point of view the avicoenoses being moderately stable: the avicoenosis of Vâlcele dam basin is the least diverse and the avicoenosis of Piteşti dam basin is the most diverse; the serotinal season is characterised by a moderate stability in the avicoenosis and the vernal season by a better stability.

On Goleşti dam basin there are few dominant species and on Bascov dam basin the strengths of the species are relatively more uniformly distributed.

The ecosystems are characterised by a great inequitability regarding the strengths of the species, more obvious in the hiemal and in the passage seasons.

The species rate of accumulation grows slowly as the reservoirs surface increases.

According to the constancy, 64 species (49.61% of all) were occasional species, 32 species (24.81% of all) were accessory species, 15 species (11.63% of all) were constant species and 18 species (13.95% of all) were euconstant.

Depending on the dominancy, 116 species (89.92% of all) were subrecedent species, 5 species (3.88% of all) were recedent species, 3 species (2.33% of all) were subdominant species, 1 species (0.78% of all) was dominant species (*Aythya fuligula*), and 4 species (3.10% of all) were eudominant species.

By Dzuba ecological significance index, 103 species (79.84% of all) were subrecedent species, 13 species (10.08% of all) were recedent species, 8 species (6.20% of all) were subdominant species, 1 species (0.78% of all) was dominant species and 4 species (3.10%) were eudominant species.

Anseriformes and Charadriiformes were the overdominant orders over the whole period.

Regarding the monthly dynamics of the orders, Anseriformes was overdominant all months, except May, when it was dominant; Charadriiformes was overdominant in January, July, August, September, and December.

As the time went by, the structure of the avifauna from the dam basins from the Argeş River has become increasingly more similar to that of a natural ecosystem.

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